J. J. Woodward, the Philadelphia Centennial, and Medical Imaging in 19th Century America

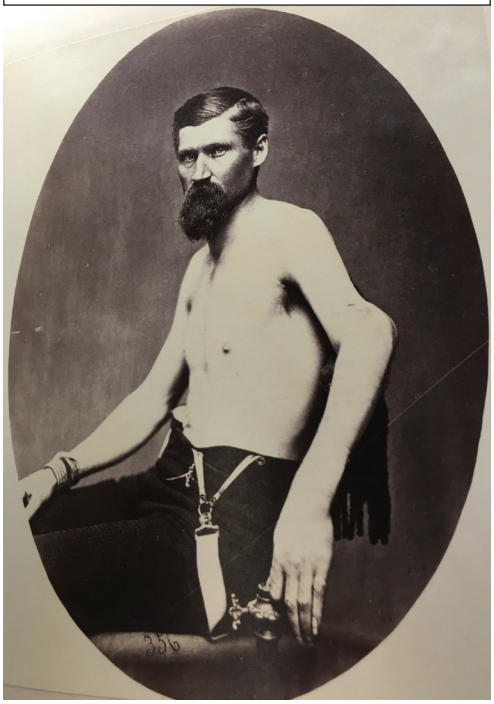
Vanessa Meikle Schulman

In his travelogue of the 1876 Philadelphia Centennial, *What Ben Beverly Saw at the Great Exposition*, James L. Dale described an exhibit that impressed him with both wonder and horror: a set of photographs documenting the outcomes of surgical operations that suggested procedures "of the most fearful character, which would seem impossible to perform, and the poor patient survive."[1] What Dale described was the US Army Medical pavilion, where the displays were designed to convince domestic and international visitors of the professionalism and innovation of American medicine and in particular to highlight the contributions of military medicine. The medical building included a full-size model of an army field hospital and multiple exhibits constituting a representative sampling of collections from the US Army Medical Museum: photographic portraits of famous surgeons; enlarged microphotographs of blood, bone, and tissue samples; images of Civil War wounds and their treatments; artifacts and supplies for surgical procedures; and a painting, Thomas Eakins's *The Gross Clinic*. Together, this collection of artifacts presented viewers with a narrative of the current American medical field, with special focus on the Civil War as a catalyst for new medical discoveries. While Eakins's painting became the most famous image from the pavilion, it was not part of the original display, which was explicitly designed to demonstrate how surgeons and medical researchers used healing knowledge to transcend the devastation of the Civil War. This essay examines the exhibit's roots in wartime medicine and research and studies how Dr. Joseph Janvier Woodward planned and developed the exhibit to communicate with the public about current medical and surgical practice.

The Centennial Exposition was a world's fair held in Philadelphia's Fairmount Park to celebrate the passage of 100 years since the signing of the Declaration of Independence. It was America's first world's fair, to be modeled on London's Crystal Palace Exposition of 1851, and was explicitly intended to showcase innovation and technological dominance as well as America's postwar rise on the global stage. As J. S. Ingram wrote in his review of the fair, the visiting nations "have seen in the crowds of American citizens... a polite, orderly, self-respecting and self-governing people."[2] The centerpiece of the fair was the Corliss engine, a massive steam engine, which generated the power to run the dozens of displays on view in Machinery Hall. The engine symbolized for many visitors both the supreme ascendance of American innovation and humankind's control over the raw power of technology.[3] Moreover, this display of American technological exceptionalism was interpreted as a blessing from God. As Reverend Matthew Simpson stated in an opening prayer to start off the fair: "We thank Thee for social and national prosperity and progress, for valuable discoveries and multiplied inventions, for labor-saving machinery..."[4] Such rhetoric positioned technological ingenuity at the heart of a nation

still rebuilding from the divisive Civil War.

Figure 1. Example of a post-surgical image showing Corporal William Ruddock, 117th New York Infantry. "Successful excision of the shaft of the left humerus."



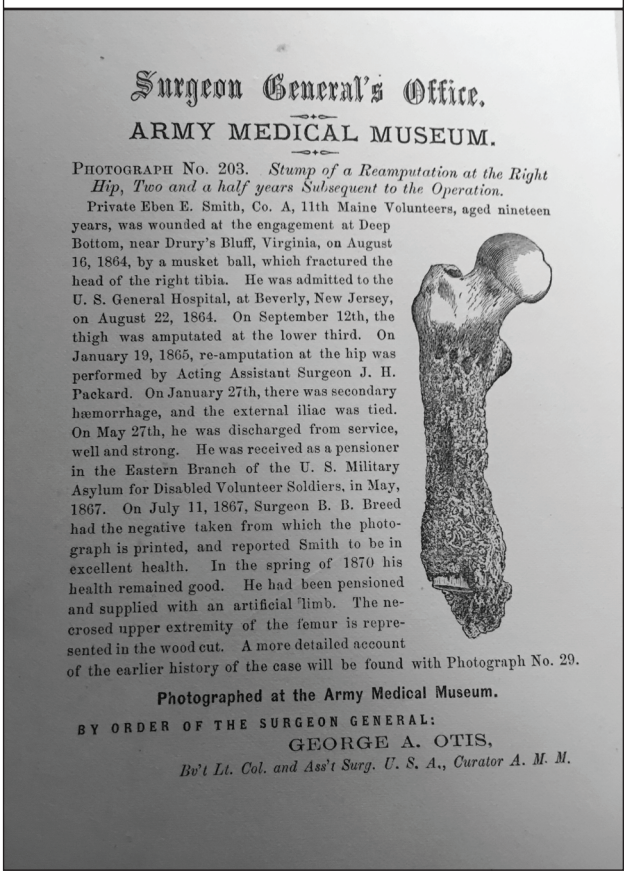
In that context, the medical display created under the auspices of the Surgeon General's office had a crucial role to play in narrating the history of American medicine and in demonstrating how medical progress evolved as a necessary response to the war. The exhibition was curated by J. J. Woodward, a wartime Assistant Surgeon, a specialist in infectious diseases, a pioneer in the technique of microphotography, and a member of the curatorial staff of the US Army Medical Museum (today the National Museum of Health and Medicine or NMHM). Woodward's prior background with the Surgeon General's office and the Medical Museum, as well as his personal investment in the study of pathological specimens through microscopic examination, strongly tilted the exhibit toward these specialties. Though he collaborated with other museum staff to put together the display, Woodward primarily controlled the didactic messages about innovations in American medicine presented to the public at the fair. In addition to Woodward's own personal concerns, the role of the Civil War in the formation of the museum ensured many of the materials on display were linked to the war's impact on medical science. These materials included specimens and photographs collected for dissemination to medical specialists but now available to the general public. This exhibit marks the first direct effort to expose laypeople to crucial developments in the American medical profession. As Julie K. Brown argues, the Centennial displays helped initiate an era dedicated to "communicating directly with the public on issues relating to health and medicine."[5] The origins of this may be found in the Civil War era.

As early as 1862, the Surgeon General's office recognized the potential of the war to advance medical science through the creation of an archive to document wounds, injuries, and diseases, the medical and surgical procedures addressing them, and their outcomes. In an 1862 letter to Secretary of War Edwin Stanton, newly appointed Surgeon General Dr. William A. Hammond wrote asking for increased funding and noted, with an eye toward compiling a "medical and surgical history of the rebellion," he had begun collecting "memoirs and reports of great interest to medical science" that were in the process of being "systematically arranged."[6] The crucial move toward the establishment of "government-funded medical research" had begun just a few months previously when Hammond established the US Army Medical Museum shortly after his appointment in May 1862.[7] Woodward was involved in this project early on, tasked with assembling statistics gathered from regimental surgeons across the Union forces. Consonant with Woodward's own experience in infectious disease, he was at first charged with collecting statistics on fatalities resulting from causes other than battle. In a February 1863 report to Hammond, later circulated before Congress, Woodward noted the historical importance of the project: "no great army actively engaged in hostile operations has ever furnished statistical tables of even approximate accuracy."[8] Woodward's initial statistical results were based upon self-reported numbers from field surgeons, which he argued could be extrapolated to achieve moderately accurate understandings of the prevalence of fatal illness in army life.[8] Woodward's counterpart on the project was Dr. John H. Brinton, whom Hammond assigned to research surgical intervention into wounds received on the battlefield.[9] Statistics and images culled from Woodward's and Brinton's examinations of the war would later be curated into Woodward's 1876 display.

Both Woodward and Brinton relied on photographic documentation to assist with their gathering of information about wartime fatalities. Brinton, who would later become the first curator of the Medical Museum, released a circular in 1863 requesting contributions from surgeons in the field. In this era, belief in the precision and accuracy of photography often stressed its role as an unbiased device for recording objective truth.[10] For instance, in 1867 the Boston-based digest magazine *Littell's Living Age* argued, "In medical and surgical science [photography's] records of malformations or morbid conditions are necessarily of more value than records which might be characterized by the imperfect observation of the recorder." The author continues, "everything, in short, where a minute record untinctured by

the prepossession or the incapacity of the recorder is of importance to the advancement of science, may receive the aid of this unerring and willing adjutor."[11] According to popular and scholarly understandings of photography's chemical and scientific properties, post-Civil War Americans generally accepted the medium as a truthful amanuensis for a variety of scientific disciplines.

Figure 2. Example of case history, for Private Eben E. Smith, 11th Maine Volunteers. "Stump of a reamputation at the right hip."



Surgeon General's Office.

ARMY MEDICAL MUSEUM.

PHOTOGRAPH No. 203. *Stump of a Reamputation at the Right Hip, Two and a half years Subsequent to the Operation.*

Private Eben E. Smith, Co. A, 11th Maine Volunteers, aged nineteen years, was wounded at the engagement at Deep Bottom, near Drury's Bluff, Virginia, on August 16, 1864, by a musket ball, which fractured the head of the right tibia. He was admitted to the U. S. General Hospital, at Beverly, New Jersey, on August 22, 1864. On September 12th, the thigh was amputated at the lower third. On January 19, 1865, re-amputation at the hip was performed by Acting Assistant Surgeon J. H. Packard. On January 27th, there was secondary hæmorrhage, and the external iliac was tied. On May 27th, he was discharged from service, well and strong. He was received as a pensioner in the Eastern Branch of the U. S. Military Asylum for Disabled Volunteer Soldiers, in May, 1867. On July 11, 1867, Surgeon B. B. Breed had the negative taken from which the photograph is printed, and reported Smith to be in excellent health. In the spring of 1870 his health remained good. He had been pensioned and supplied with an artificial limb. The necrosed upper extremity of the femur is represented in the wood cut. A more detailed account of the earlier history of the case will be found with Photograph No. 29.

Photographed at the Army Medical Museum.

BY ORDER OF THE SURGEON GENERAL:

GEORGE A. OTIS,

Bv't Lt. Col. and Ass't Surg. U. S. A., Curator A. M. M.

Recognizing the visual potential of photographic documentation, Woodward and Brinton asked for both written and photographic records of "the collected results of the gunshot injuries of the war, and of the operations performed for their relief." The Surgeon General's office, they continued, "would ask every Physician and Surgeon, who in the course of his practice may be called upon to treat, any officer or soldier previously wounded in service, carefully to note the results of the case."[12] While still under the pressures of wartime, the collection began to grow as medical professionals and government officials recognized the potential usefulness of amassing photographic documents. Just 2 years after the end of the war, librarian and historian Fred B. Perkins described the collection as a "vast mass of reports and documents" that will form "an invaluable contribution to medical and surgical science."[13] Donations of specimens, photographs, and case histories from doctors across the country continued to arrive in the years following the war.[14]

The most well-known result of the collection and analysis of these materials was the 6-volume illustrated work, *The Medical and Surgical History of the War of the Rebellion*, published between 1872 and 1888. A massive undertaking, this compendium included lavish illustrations, statistics, and discussion of the treatments of injuries and diseases specific to war. Former archivist at NMHM, Michael Rhode, has written extensively about the creation and reception of these volumes, whose publication was ongoing even as Woodward was planning the Centennial display.[15] Reviews of the *Medical and Surgical History* reflected directly on the fact the Civil War had provided an unlooked-for opportunity to advance medical science. As the premier British medical journal *The Lancet* wrote in 1873:

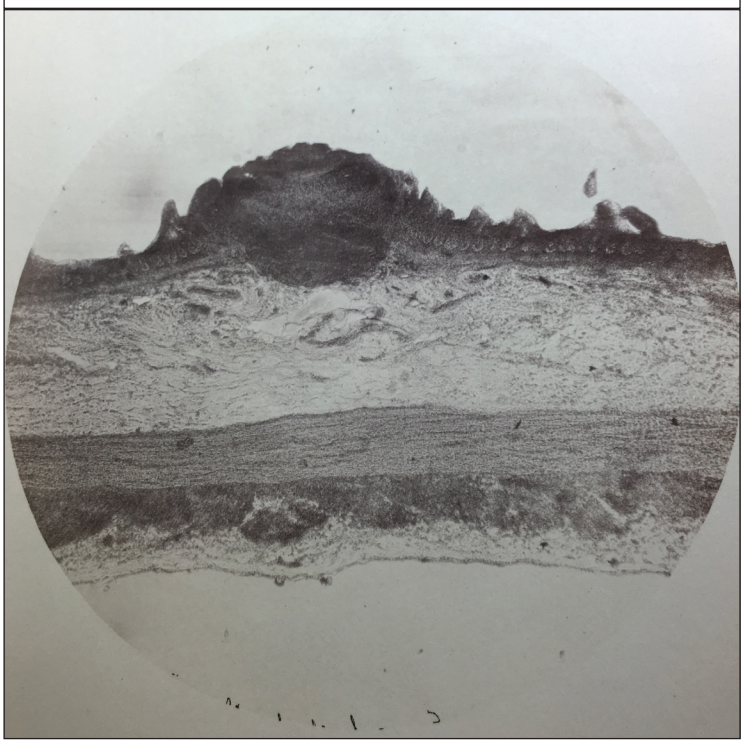
> It is well that no benefit which can be gathered out of the wide-spread suffering caused by the war should be lost. [... If] the experience gained in the hospitals can be utilised for the improvement of medical and surgical knowledge, and thus for the future benefits of mankind, an additional compensation will be made for the calamities which the war occasioned. A study of the first part of the medical and surgical history of the war leads us to hope that we may reasonably expect this advantage will accrue; that [...] the science of healing in general be advanced, and that thus, as so often has occurred before, out of evil good will come.[16]

It is clear the books were a potentially valuable undertaking. However, their high cost was prohibitive, and they would likely only have been seen in the libraries of medical colleges. By contrast with these weighty and inaccessible volumes, the imagery on display at the 1876 Centennial constituted a more vital and accessible form of visual culture celebrating the growth of the medical profession in the US, while remembering the ravages of the war.[17]

In March 1875, Hammond's successor as Surgeon General, Dr. Joseph K. Barnes, selected Woodward for the task of "collecting, arranging and displaying such stores, materials, &c., pertaining to the Medical department as it may be desirable to place on exhibition at the 'International Exhibition.'"[18] Woodward began by planning the hospital building itself, and shortly after a construction bid was accepted in July, he set to work deciding how to fill the space.[19] That summer, he requested from the surgeon general "a complete series of the medical supplies

used in the Army, including medicines, medical and surgical instruments, hospital stores, hospital clothing and furniture, meteorological instruments."[20] In addition to contemporary items, historical artifacts dating back to the Revolutionary War would help create a progressive timeline of American military medicine. The exhibit would ideally be staffed by 8 full-time docents, required to be "persons of intelligence, capable of being instructed in the uses, &c, of the articles exhibited under their charge, so as to be able to explain them to visitors."[21] This vast effort was directed toward proving the idea "[...] science and humanity go hand in hand, that quackery is an immorality—that the defence [sic], support, and encouragement of legitimate organized medicine is essential to the good order of society."[22] Though he sometimes chafed against the "excessive demands on my time made by the Centennial arrangements," it is clear that Woodward took this responsibility very seriously.[23]

Figure 3. Example of a photomicrograph by William Thompson, unknown patient. "Perpendicular section of ileum."



For more than year, Woodward worked with his colleague Dr. George Otis, the chief curator of the museum, putting together the display to chronicle the history of America's medical profession, from the Revolution to the recent conflict.[24] Having both been intimately involved in the publication of the *Medical and Surgical History*, Woodward and Otis were well aware of the impact of visual media as they planned the exhibit at Philadelphia. In January 1876, just months before the fair was set to open, Otis wrote to Woodward estimating his proposed surgical displays at "a selection of from 150 to 200 specimens," supplemented by an extensive image program: "I should think it well to present many photographs and drawings in volume and portfolios and some larger pictures might be hung to the walls if there is adequate space."[25] Working together to select the images and artifacts, Otis and Woodward decided on a visually rich exhibit, which placed great emphasis on the display of photographic materials from the museum's collection.

After the construction of the building itself, costing $11,446, the printing and framing of photographic materials was one of the largest fair-related expenditures, totaling $1,042.[26] In total, 128 photomicrographs, 39 photos of surgeons, wounds, and surgeries, and 246 specimens were on exhibit in the pavilion.[27] Special cases had to be built to house the specimens and instruments, while the upper portions of the walls held framed portraits of surgeons, large-scale photomicrographs, and "photographs of difficult and successful amputations."[28] Woodward also included additional photographs for visitors to look through, printed in large-format bound books of sturdy cardstock (Figure 1). These included one volume of surgical photographs and one of photomicrographs, "handsomely bound for exhibition at our hospital on the Centennial grounds."[30] The book of surgical photographs, selected by Otis, included case histories on the verso of each page, outlining the rank, regiment, battle experience, wound, treatment, and prognosis for each veteran pictured (Figure 2). The book of photomicrographs, taken by Army Assistant Surgeon Dr. William Thomson in 1864, represented a major focus of Woodward's medical career and expertise.

Though photomicrographs had been taken using a solar microscope since the 1840s by European scientific researchers, in 1870 Woodward's experimentation with artificial illumination allowed him to capture specimens at a higher degrees of magnification and with greater consistency than previously: "clearer and better defined than any photographs of similar objects I had hitherto seen produced by sunlight," in Woodward's estimation.[31] These experiments, which Woodward conveyed to Surgeon General Barnes in January 1870, preceded the common use of magnesium-based flash powder for indoor photography. Woodward was well known within the scientific community as a pioneer of photomicrographic research and was cited in American medical

journals as an expert in microscopy.[32-38] It is not surprising, then, he chose to focus his curatorial efforts for the Centennial on this topic.

The photomicrographs on display were taken from Woodward's own experiments, from Army collections, and from pre-war efforts by noted scientists such as John William Draper, who took the first known Daguerreotype images of the moon and was a pioneer in American photomicrography.[39] The bound book of photomicrographs on display at the Centennial contained 12 images taken by Woodward's collaborator and correspondent William Thomson during the war. These included sections of diseased colon and intestine, affected by the common camp diseases typhoid and dysentery, which were objects of Woodward's wartime research. The frontispiece of the volume explained to viewers these images "demonstrate the value of photomicrography and its possibility, with the compound microscope then issued by the Surgeon Generals Office to the general hospitals."[40] Thomson's images combined with Woodward's research chronicle a trajectory of scientific innovation spurred by the war and would benefit the public by helping doctors understand and visualize the inner workings of the human body. However, the images are also among the most abstract and striking on display, not only in the medical pavilion but in the entire Centennial.

In a review in the specialist journal *Medical and Surgical Reporter*, the bound volumes of Thomson's photomicrographs received notice as "the beautiful photomicrographs, now produced at the Army medical museums." The author continued by urging "all visitors to give them the closest attention, as they are unsurpassed by any in art."[41] Indeed, the layered striations of these magnified specimens of diseased colons and bone fragments are marvelous for their ability to aestheticize disease (Figure 3). Clearly created to serve the aims of research and medical exploration, the photomicrographs were also beautiful objects that allowed viewers to push visually into unknown territory: the interior of the human body. The gorgeously framed images even strongly resembled other images of exploration: photographs of western lands recently opened up by the expansion of the railway. Indeed, in the same day a visitor to the exposition might have seen both sets of images: in another quarter of the fairgrounds, the Photographic Hall featured 34 of Carleton Watkins's large-format photographs of Yosemite, as well as landscape works of the west by Charles Leander Weed and Eadweard Muybridge.[42] The parallel may be extended further when we learn some of the photomicrographs rivalled Watkins's in their grand scale: in addition to Thomson's images, Woodward included huge photomicroscopic studies from his own research, noting to a correspondent with evident glee he enlarged his "photo-micrographs to two and three feet in diameter. They bore the enlargement well."[43] Geological survey photography and enlarged microscopic images were located in close spatial proximity on the fairgrounds and possessed evident similarities of composition and scale. But beyond this surface parallel, both types of practitioners also pushed the new medium of photography to reveal unknown spaces.

This pavilion was one of the few places where ordinary visitors from outside the medical profession would have had the opportunity to view such images. However, Woodward had no high opinion of the intelligence of the average fair-goer. In a letter to a fellow micrography enthusiast, John Mayall, Jr., Woodward wrote:

> [...] a tide of Centennial visitors from the West drifts daily to the number of many hundreds... each with his or her linen duster, carpet bag, and lunch in hand—and I assure you they constitute a new, characteristic and laughter-provoking species of the genus homo—well worthy of your appreciative study."[44]

His dismissive attitude fits with other, more intentionally satirical responses to the Centennial's supposed didactic function, such as a guide written by the humorist George G. Small under the pseudonym "Bricktop," illustrated with grotesque caricatures of American rural types on whom the fair's message of progress is lost entirely.[45] And when a Centennial judging panel awarded a medal to "exhibitors of homeopathic medicines and other irregulars," Woodward did not bother to veil his disdain, remarking: "the incompetency of Drs. Thompson and White as medical judges is so notorious."[46] On the whole, the exhibit was deemed a success by medical professionals, including some well-regarded European doctors, but Woodward worried the distinction between serious science and commercial pageantry had been conflated by many visitors. Nevertheless, this was the first, and in many cases the only, opportunity for many lay people to gain firsthand visual knowledge of the state of the medical profession in these years.[47]

In conclusion, the display Woodward curated at the medical pavilion of the Centennial was an important space for civilians and those not affiliated with the medical profession to learn about the innovations in American medicine spurred by the Civil War. Though Dr. J. J. Woodward is remembered more for his work with infectious diseases and for his stewardship of the *Medical and Surgical History*, it is important to study the innovative techniques and images he selected to communicate the goals and achievements of the Medical Museum to the fair's visitors. The US Army Medical Museum's

1876 Centennial exhibit was a culmination of wartime and postwar efforts using medical imagery and artifacts to stress the contributions of military medicine and research to American life.

Acknowledgments

The author would like to thank Laura Cutter at the National Museum of Health and Medicine archives for her assistance with this research. This essay is dedicated to the memory of the author's grandfather, COL Wendell A. "Mike" Meikle. All figures were taken by the author and are from the bound books displayed in the Army Medical exhibit of the 1876 Centennial.

References

1. Dale JL. *What Ben Beverly Saw at the Great Exposition*. Chicago: Centennial Publishing; 1876:72.
2. Ingram JS. *The Centennial Exposition, Described and Illustrated*. Philadelphia: Hubbard Brothers; 1876:645.
3. Schulman VM. *Work Sights: The Visual Culture of Industry in Nineteenth-Century America*. Amherst: University of Massachusetts Press; 2015:12-17.
4. Ingram JS. *The Centennial Exposition, Described and Illustrated*. Philadelphia: Hubbard Brothers; 1876:82.
5. Brown JK. *Health and Medicine on Display: International Expositions in the United States*. Cambridge, MA: MIT Press; 2009:9.
6. Hammond WA. Correspondence, Orders, Reports, and Returns to the Union Authorities from April to December 31, 1862: Letter to Edwin M. Stanton, Nov. 10, 1862, in *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies, series III, vol. II, series 123*. comp. Fred. C. Ainsworth and Joseph W. Kirkley Washington, DC: Government Printing Office; 1899:753.
7. Rhode M. "'The Extent of These Materials is Simply Enormous:' The Creation and Publication of *The Medical & Surgical History of the War of the Rebellion from 1862 to 1888*." PDF of paper delivered at the Annual Meeting of the American Association for the History of Medicine, May 2, 2004, provided courtesy of the National Museum of Health and Medicine (NMHM), 3.
8. Woodward JJ. The health of the Army: important report of surgeon Woodward to surgeon-general Hammond. *Medical and Surgical Reporter*. May 2, 1863;14.
9. Hammond, WA. News and miscellany. *Medical History of the War, Medical and Surgical Reporter*. June 28, 1862:VII;329.
10. Brown JK. *Making Culture Visible: The Public Display of Photography at Fairs, Expositions and Exhibitions in the United States, 1847-1900*. Amsterdam: Harwood Academic Publishers. 2001; 99.
11. Photography: its history and applications. *Littell's Living Age*. Boston: Littell Son, & Co. January 26, 1867;1182(43):216.
12. Draft of circular of February 20, 1863. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 6, Circulars and Reports, Box 1, Folder 3.
13. Perkins FB. Our doctors in the rebellion. *Galaxy*. November 1867;4(7):823-824.
14. Rhode MG, Conner JTH. A repository for bottled monsters and medical curiosities: the evolution of the army medical museum. In: Levin AK, ed. *Defining Memory: Local Museums and the Construction of History in America's Changing Communities*. Walnut Creek, CA: Altamira Press; 2007: 180-82.
15. Rhode M. "'The Extent of These Materials is Simply Enormous:' The Creation and Publication of *The Medical & Surgical History of the War of the Rebellion from 1862 to 1888*." PDF of paper delivered at the Annual Meeting of the American Association for the History of Medicine, May 2, 2004, provided courtesy of the National Museum of Health and Medicine (NMHM), 27-38.
16. Review from *The Lancet*, Aug. 30, 1873, 303. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 18, Curatorial Records: Notices of Army Medical Museum Publications, Box 2, Vol. 3, p. 11. of scrapbook.

17. Barnes letter to S. C. Lyford, May 5, 1875, in Joseph Janvier Woodward Letter-book, 1875-1877. MS F 230, Manuscripts Collection, History of Medicine Division, National Library of Medicine, quoted in Brown, *Health and Medicine*, 32.

18. Woodward JJ. Letter to S. C. Lyford, April 3, 1875. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28, Curatorial Records, Woodward Letterbooks, Box 5, Vol. 9, p. 54.

19. Planning for the construction is outlined in several letters in National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28, Box 5, Vol 9: Woodward, letter to A. H. Hoff, Apr. 20, 1875, pp. 57-58; Woodward, letter to S. C. Lyford, July 3, 1875; and Woodward, letter to A. Doan, July 29, 1875, p. 95.

20. Woodward JJ. Letter to S. C. Lyford, Aug. 2, 1875. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 5, Vol 9, p. 109.

21. Woodward JJ. Letter to the Surgeon General's Office, Nov. 22, 1875. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 5, Vol 9, p. 172.

22. The Medical and Surgical History of the War of the Rebellion. *The Medical Record*, April 15, 1873. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 18. Box 2, Vol 3, p. 24.

23. Woodward JJ. Letter to John Mayall, Jr, June 1, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 6, Vol 10, p. 85.

24. Woodward JJ. *The Medical Staff of the United States Army, and Its Scientific Work; An Address Delivered to the International Medical Congress at Philadelphia, Wednesday Evening, September 6, 1876*. Washington, DC: Gibson Brothers Printers; 1876.

25. Otis G. Letter to Woodward, Jan. 13, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 15. Letterbooks of the Curators, Box 7, p. 497-498.

26. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 12. Curatorial Records: Expositions Box 1, Folder 1.

27. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 12. Box 1, Folder 2.

28. Otis G. Instructions for the construction of the shelves in letter to Woodward, Jan. 13, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 15. Box 7, p. 497.

29. McCabe JD. *The Illustrated History of the Centennial Exhibition*. Cincinnati: Jones Brothers and Co. 1876; 651.

30. Woodward JJ. Letter to William Thomson, May 8, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Woodward Letterbooks, Box 6, vol 10, p 65.

31. Woodward JJ. On the magnesium and electric lights, as applied to photo-micrography. *American Journal of Science and Arts*. May 1870;49(147):294.

32. Cox JD. Joseph Janvier Woodward, MD [obituary]. *Proceedings of the American Society of Microscopists, Seventh Annual Meeting*. Buffalo: Bigelow Brothers Printers. 1884; 253-257.

33. Service of Dr. Smith. University College Hospital: Stone in the Bladder. *The Medical and Surgical Reporter, A Weekly Journal, October 1858-April 1859, vol 1*. Philadelphia: Crissy & Markley. 1859; 68.

34. Photography applied to the microscope. *The Medical and Surgical Reporter, A Weekly Journal, July 1866-December 1866, vol XV*. Butler SW, ed. Philadelphia: Crissy & Markley. 1866; 21-22.

35. The history of minute blood vessels. *Chicago Medical Examiner*. November 1870;11:702-704.

36. Cox JD. High-Angled Objectives with Wenham's Binocular. *The American Journal of Microscopy and Popular Science*. March 1878;3:54-56.

37. The size of the blood-corpuscle. *The American Journal of Microscopy and Popular Science 5*. March 1880;3:65-68.

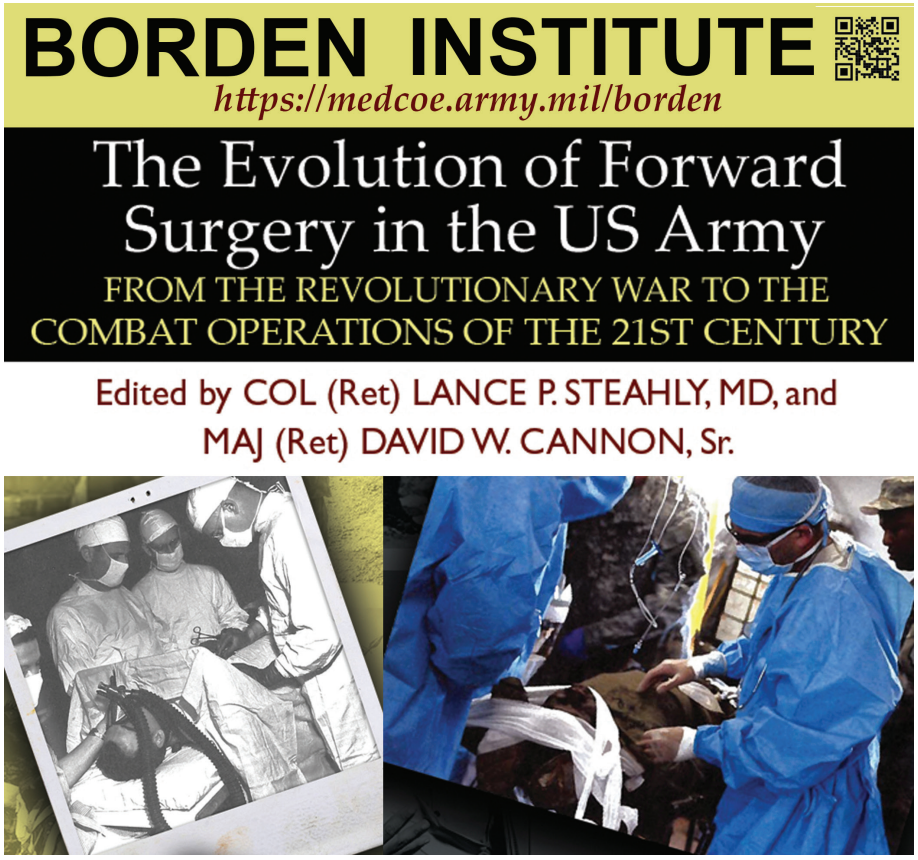
38. Pepper W. Report of the Director of the Bureau of Medical Services. In *United States Centennial Commission, Report of the Director-General Including the Reports of the Bureaus of Administration: International Exhibition 1876, vol. 1*. Washington DC: Government Printing Office. 1880; 668. Cited in Brown, *Health and*

Medicine. 19-20.

39. Woodward JJ. Letter to Prof. Henry Draper, March 17, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 6, Vol 10, p. 44.
40. Thomson W. Thomson Photomicrographs. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 330. Box 1, International Exhibition Photo-Micrographs, Philadelphia 1876.
41. Correspondence: The Centennial International Exhibition, Letter I. *Medical History of the War, Medical and Surgical Reporter.* June 3, 1876:458.
42. Brown JK. *Making Culture Visible: The Public Display of Photography at Fairs, Expositions and exhibitions in the United States 1847-1900.* Routledge;2001:73-77.
43. Woodward JJ. Letter to John Mayall Jr, June 1, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 6, Vol 10, p. 89.
44. Woodward JJ. Letter to John Mayall Jr, Sept. 1, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 6, Vol 10, p. 153.
45. Bricktop [George G. Small]. *Going to the Centennial, and A Guy to the Great Exhibition*. New York: Collin & Small; 1876.
46. Woodward JJ. Letter to Dr. P. D. Keyser, Dec. 24, 1876. National Museum of Health and Medicine. Silver Spring, MD: Otis Historical Archives 28. Box 6, Vol 10, p. 225.
47. Brown JK. *Health and Medicine on Display: International Expositions in the United States*. Cambridge, MA: MIT Press; 2009:40.

Author

Vanessa Meikle Schulman serves as assistant professor, Department of History and Art History at George Mason University, VA. This manuscript was winner of the Spurgeon Neel Annual Award (2018/2019) for the journal article best exemplifying the history, legacy, and traditions of the Army Medical Department, as established in 2003.


BORDEN INSTITUTE
https://medcoe.army.mil/borden
The Evolution of Forward Surgery in the US Army
FROM THE REVOLUTIONARY WAR TO THE COMBAT OPERATIONS OF THE 21ST CENTURY
Edited by COL (Ret) LANCE P. STEAHLY, MD, and
MAJ (Ret) DAVID W. CANNON, Sr.

This content is in the Public Domain.